



# Intel Delivers Photomask for EUV Lithography

Technology & Manufacturing Group  
Intel Mask Operations &  
Components Research  
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# What are we talking about?

- An important milestone in making Extreme Ultra Violet (EUV) lithography the next generation litho standard for the industry
- Intel has developed & delivered the first industry-standard format photomask for EUV
- Demonstrates litho capability which can extend four generations beyond Intel's current 0.13-micron process generation.
- Moore's Law scaling will continue on silicon wafers through the end of the decade.

# What's the difference between EUV masks and those used today?

- **Standard masks transmit Deep Ultra Violet (DUV, 248nm) light**
  - Light passes through the mask like light through a photonegative
- **EUV light (only 13nm!) is absorbed in the atmosphere and by most materials – EUV masks must reflect rather than transmit light**
  - Novel process developed by EUV LLC used to create reflective surface
    - Special mask substrate coated with multiple atomically thin layers of silicon and molybdenum
  - Intel researchers demonstrated that EUV masks can be created using an extension of existing mask-making technology
    - Patterns are created on these “mask blanks” with an absorber

# Why are masks important?

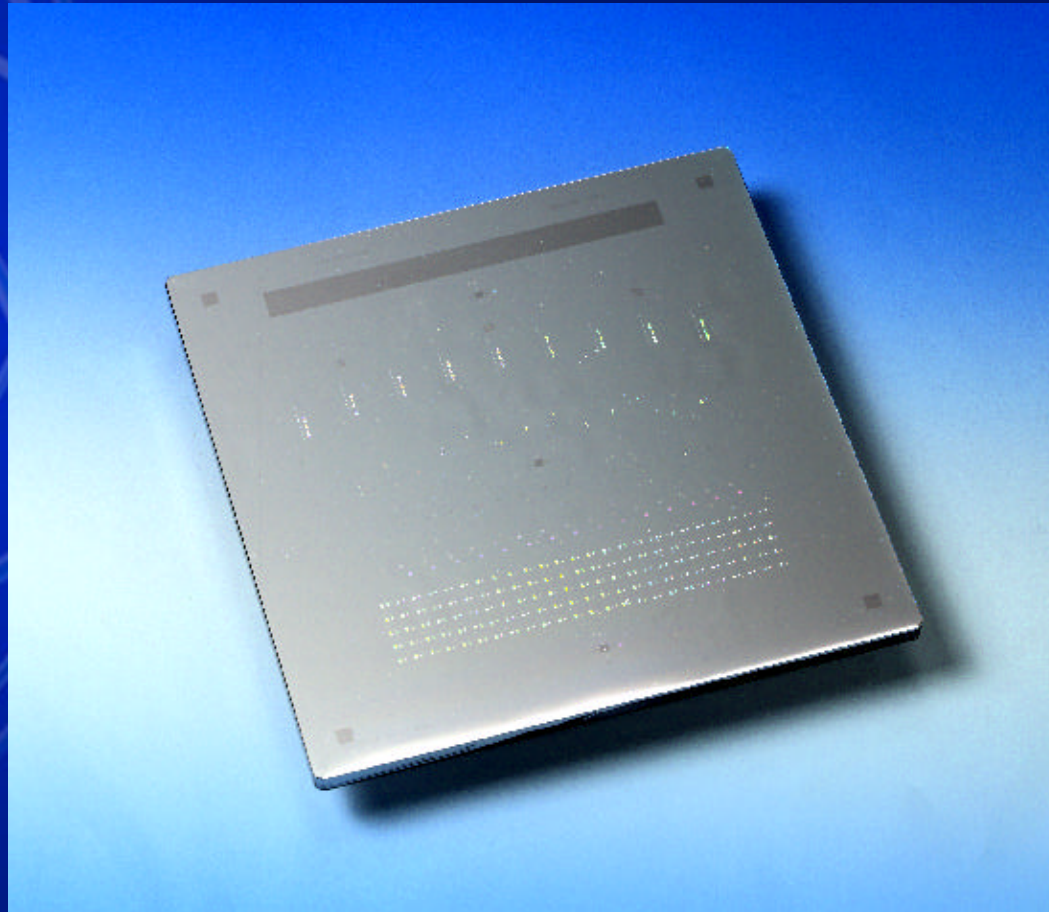
- Masks serve the same function as negatives in photography.
  - Lithographic steppers tool acts as the printing tool
  - Mask must be demonstrated before stepper
- The mask contains all of the detailed device information which is printed onto silicon
  - Any defects in the mask become defects in silicon

# EUV Limited Liability Corporation (EUV LLC)

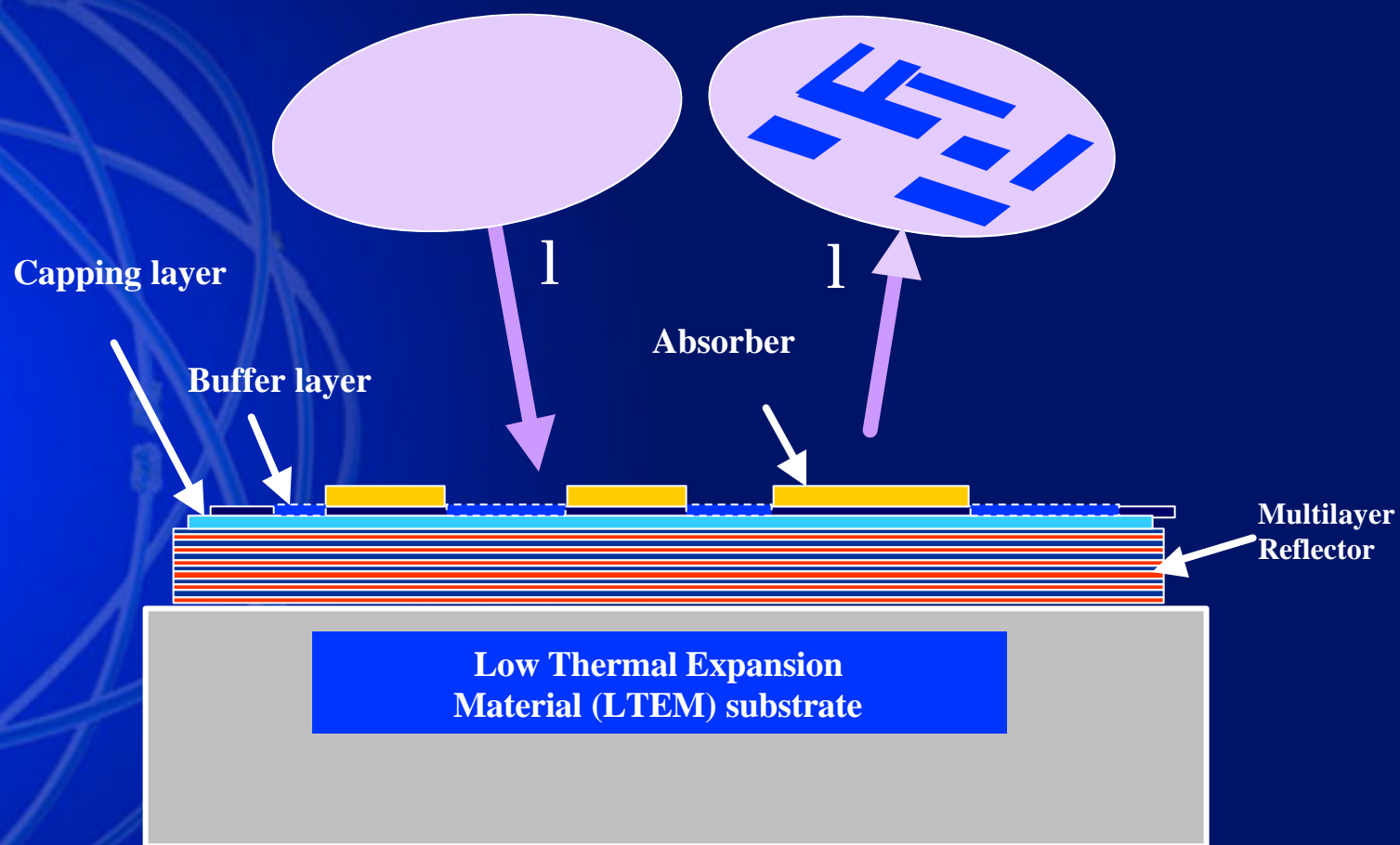
- A consortium of semiconductor companies
  - Intel, Motorola, AMD, Micron and Infineon
  - Member companies fund 100% of EUV technology development at the EUV Virtual National Laboratory (VNL)
  - VNL combines efforts of Lawrence Berkeley, Lawrence Livermore and Sandia National Laboratories
- Charter: To develop and demonstrate EUV technology as a commercially viable technology for the next generation of lithography



# World First 6-inch EUV ETS Mask

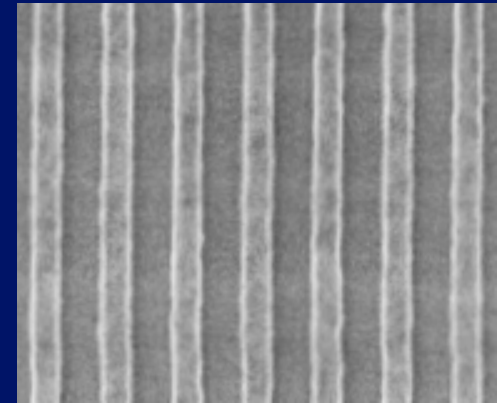
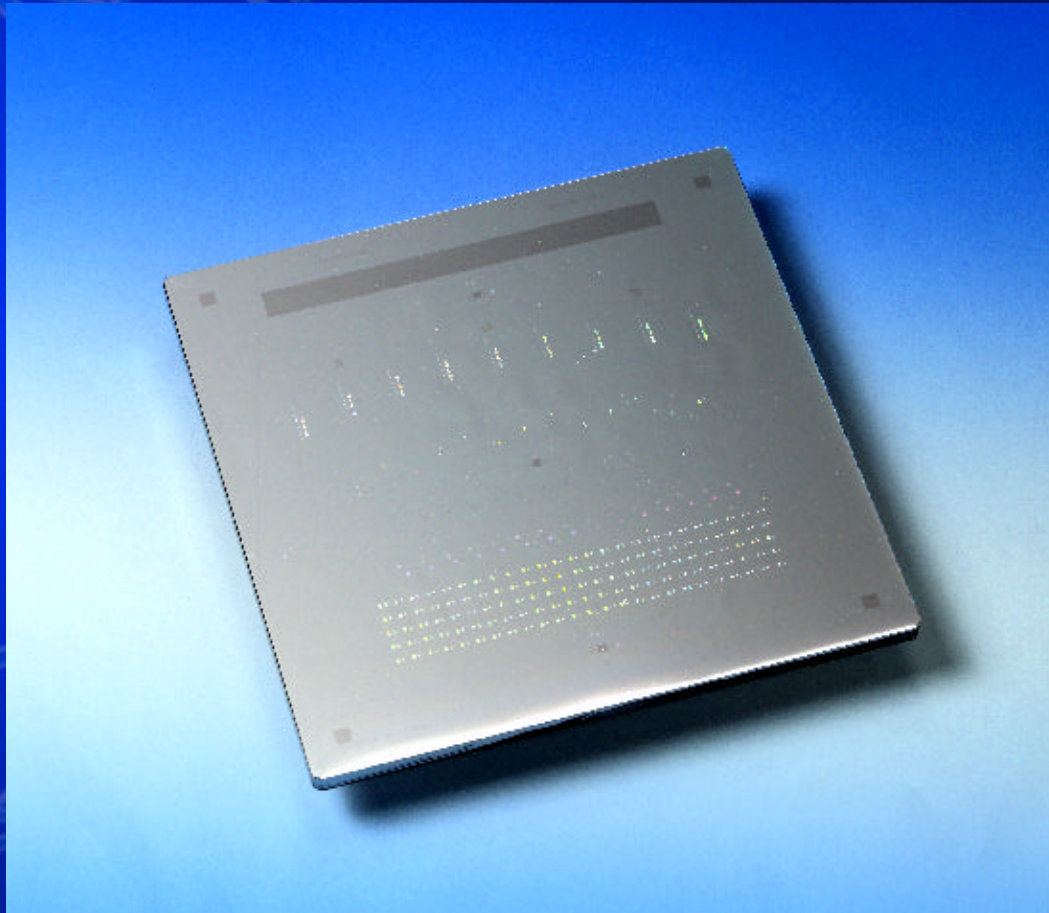


## *EUV mask making revolution: Reflective masks*



*Mask structure with incident and reflected EUV light*

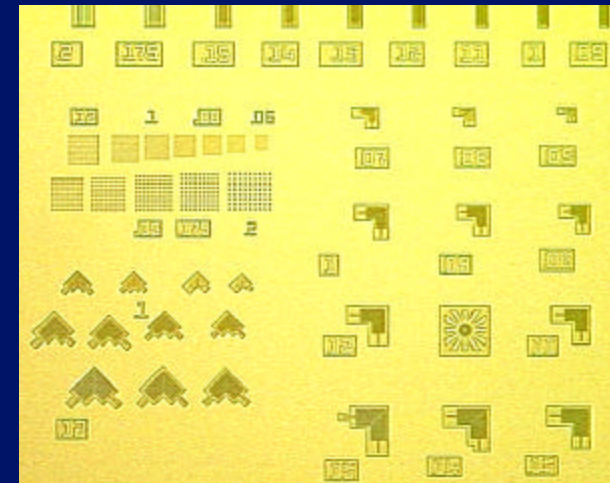
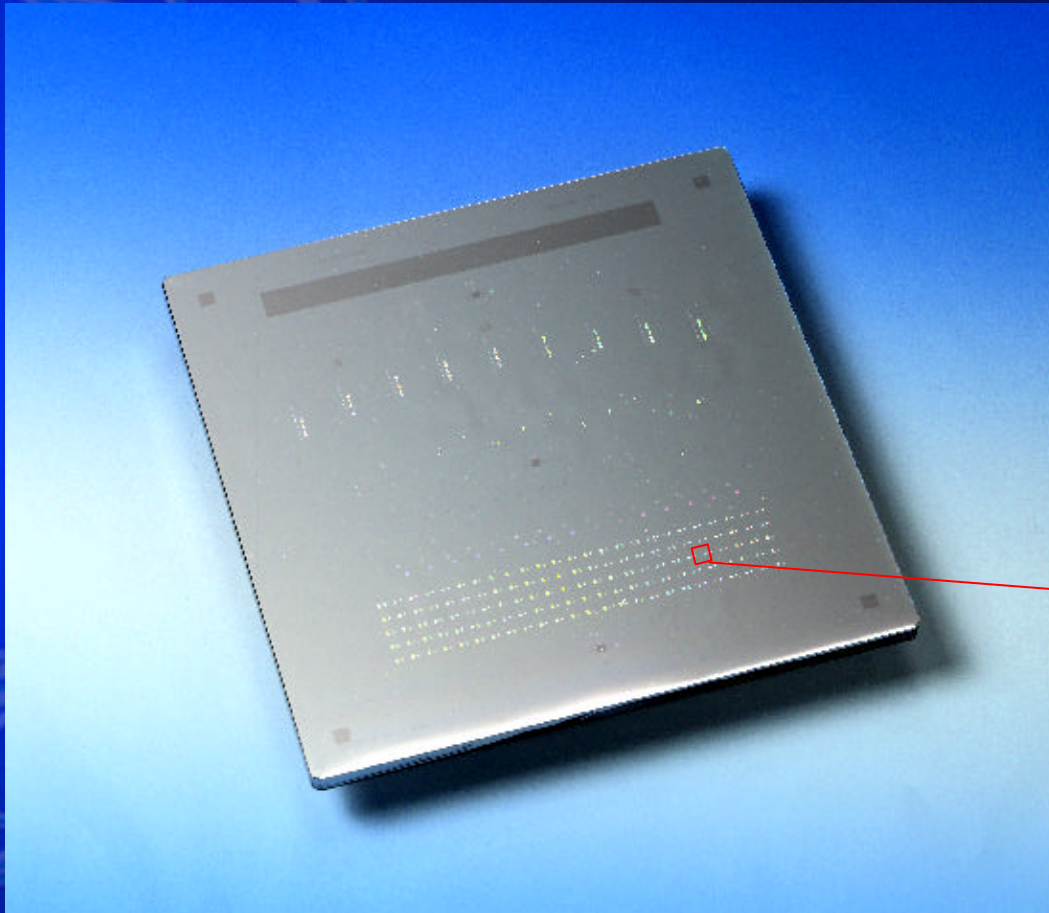
# World's First 6-inch EUV ETS Mask



*200 nm lines/spaces  
for 50 nm node*



# World's First 6-inch EUV ETS Mask

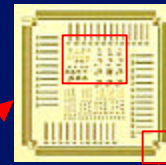
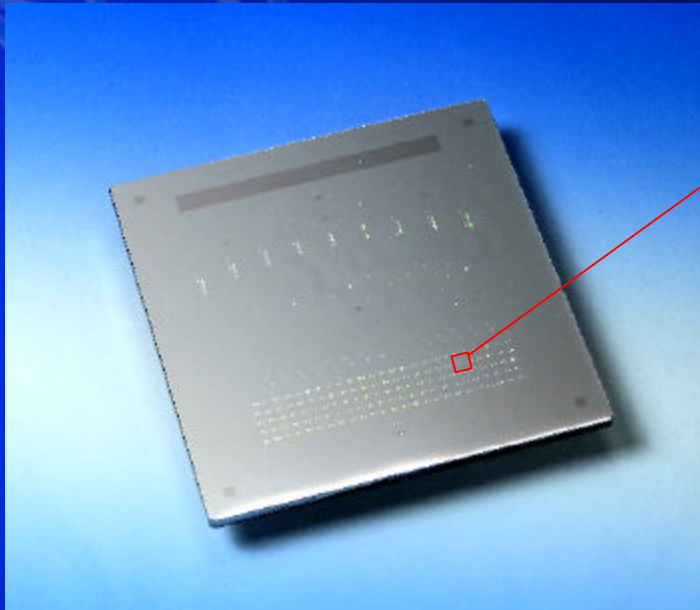


*Various test patterns*

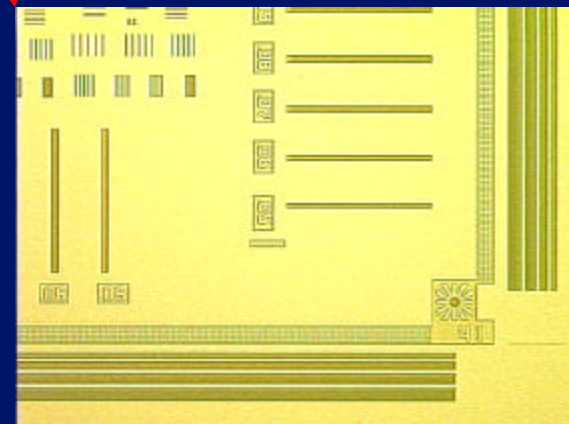
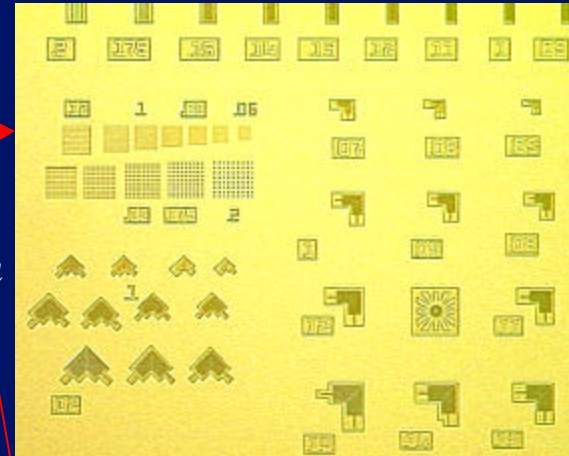


*1mm x 1mm  
sub-cell*

# World's First 6-inch EUV ETS Mask



*1mm x 1mm  
sub-cell*



# When will EUV go into manufacturing?

- We expect to start using EUV technology starting in 2005
  - Technology extendable beyond end of decade

# Intel Labs Research

- We still have not found a fundamental barrier to extending Moore's Law
- Ongoing research includes:
  - 157nm Lithography
  - EUV Lithography
  - New transistor materials and structures
  - Novel memory devices



# Intel's Technology Edge

- Research to Development to Manufacturing pipeline
- Fastest transistors in the industry
- Advanced Lithography
- Voltage scaling for low power

**Intel's logic technology continues to lead the industry**



# Q & A

- For information on Intel's silicon technology, please visit the new Silicon Showcase at [www.intel.com/research/silicon](http://www.intel.com/research/silicon)
- Please visit [www.intel.com/labs](http://www.intel.com/labs) for more information on Intel's leading edge technologies, from silicon to software